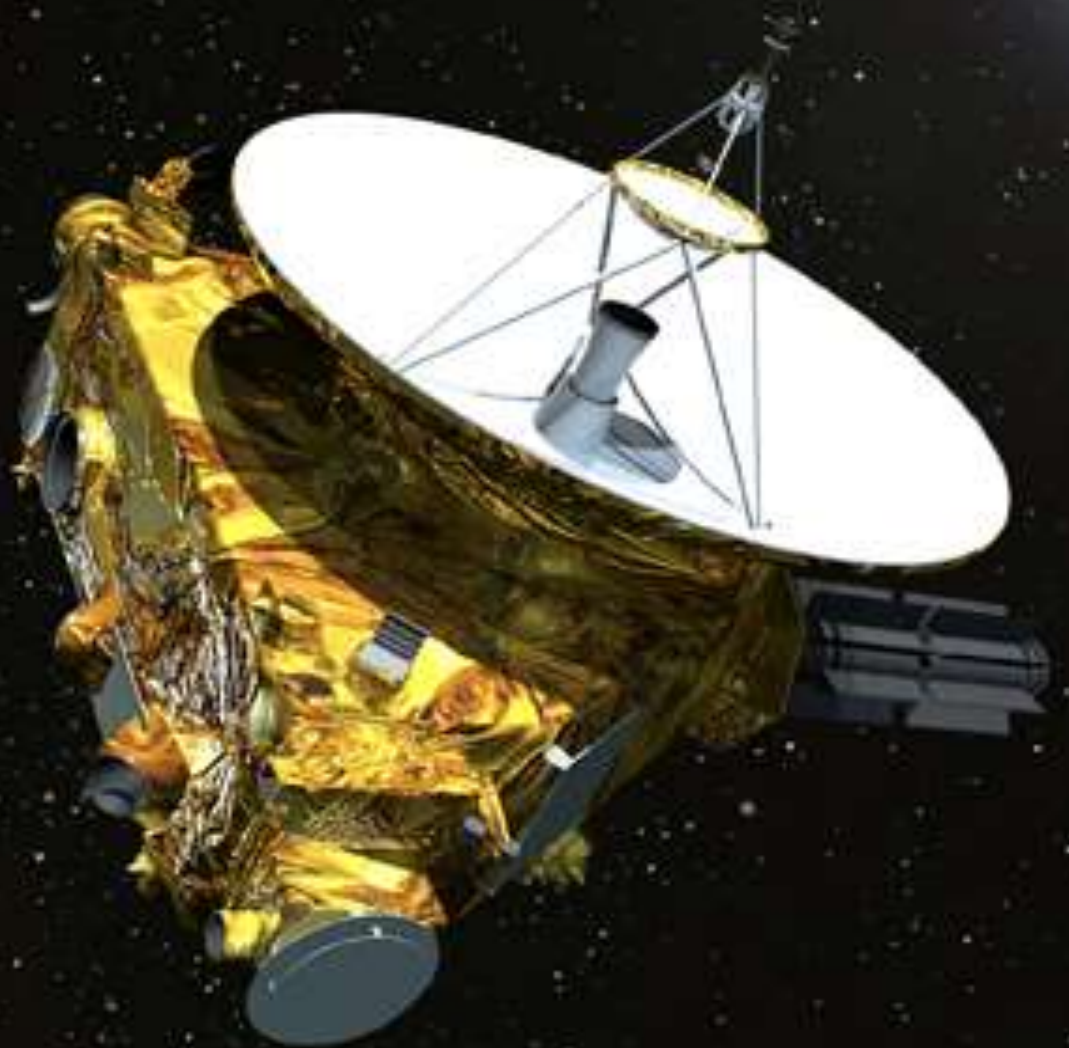


# New Horizons



***Mission to Pluto and the Kuiper Belt***

# To Pluto and Beyond

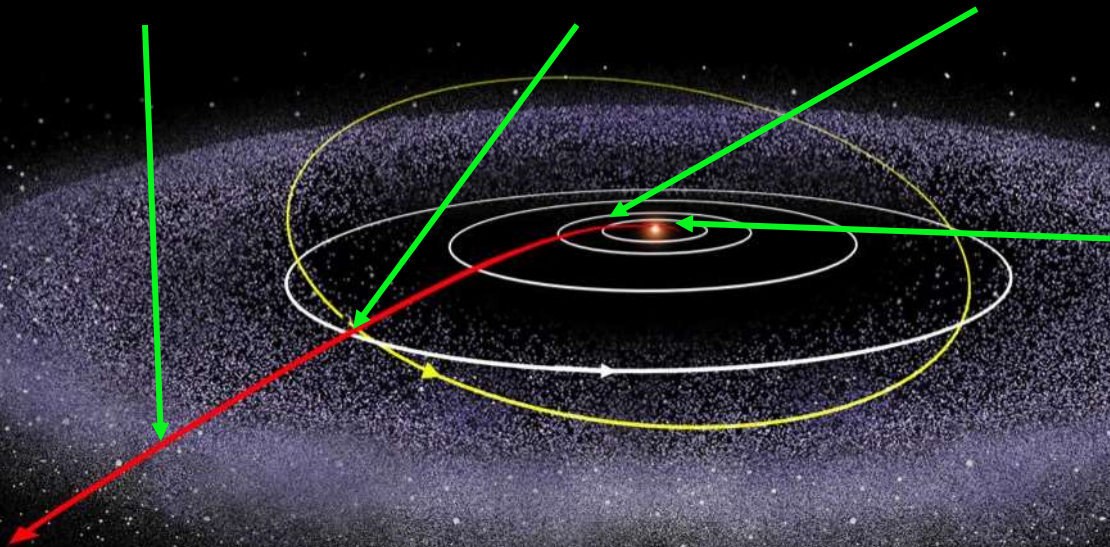
*The Initial Reconnaissance of the Solar System's 'Third Zone'*

**KBOs**  
**2016-2020**

**Pluto System**  
**July 2015**

**Jupiter System**  
**Feb-March 2007**

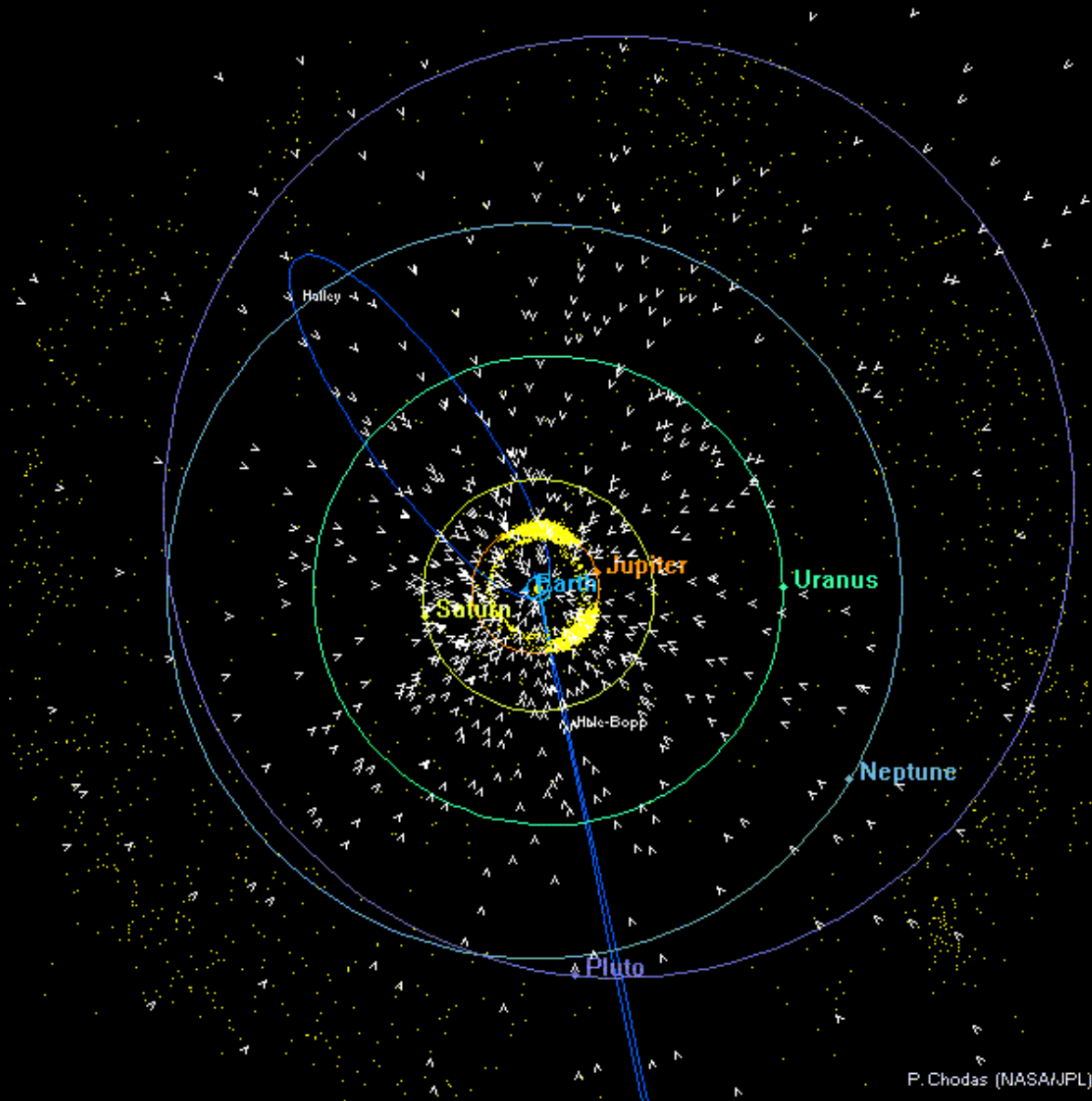
**Launch**  
**Jan 2006**



***New Horizons is NASA's first New Frontiers Mission***

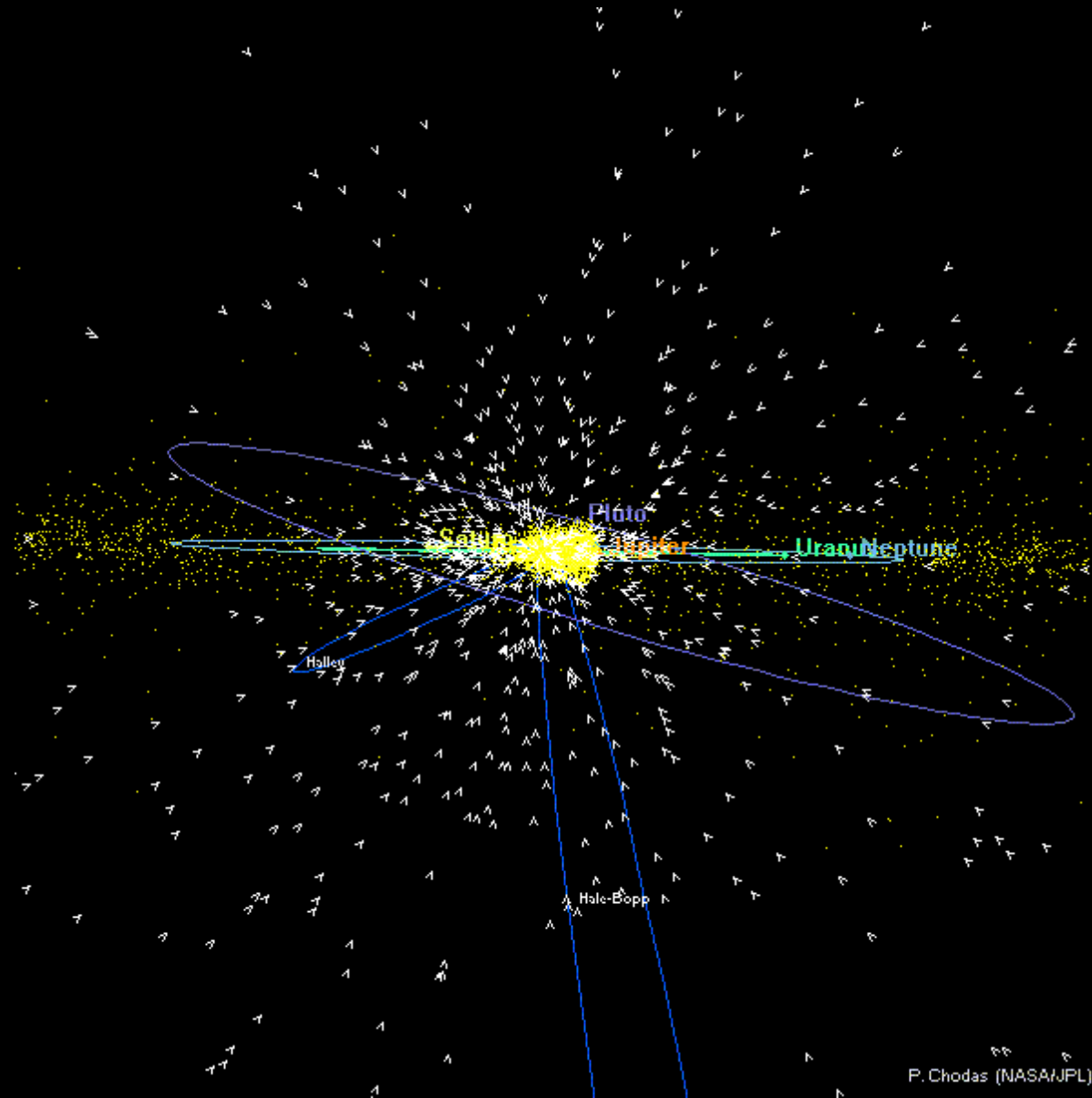
# Frontier of Planetary Science

- A whole region of the solar system we didn't even know existed until the 1990s
- Pluto is no longer an outlier!
- Pluto system is prototype of KBOs
- *New Horizons* will give us the first close-up view of these newly discovered worlds



# Frontier of Planetary Science

- The orbits of KBOs are very different from this of the “major” planets in the *ecliptic plane*
- KBO orbits are more inclined and more elongated





# What Do We Know about Pluto?

- Orbit: highly elliptical (0.25); highly inclined (17 deg);  
*248 years*
- Rotational period: 6.387230 days
- Small (diameter: 2,362 kilometers [+/- 24 km])
- Rock/ice object (“Icy Dwarf”)
- Density:  $1.89 \text{ g cm}^{-3}$  (+/-  $0.06 \text{ g cm}^{-3}$ )
- Mass:  $0.00218 M_{\text{earth}}$



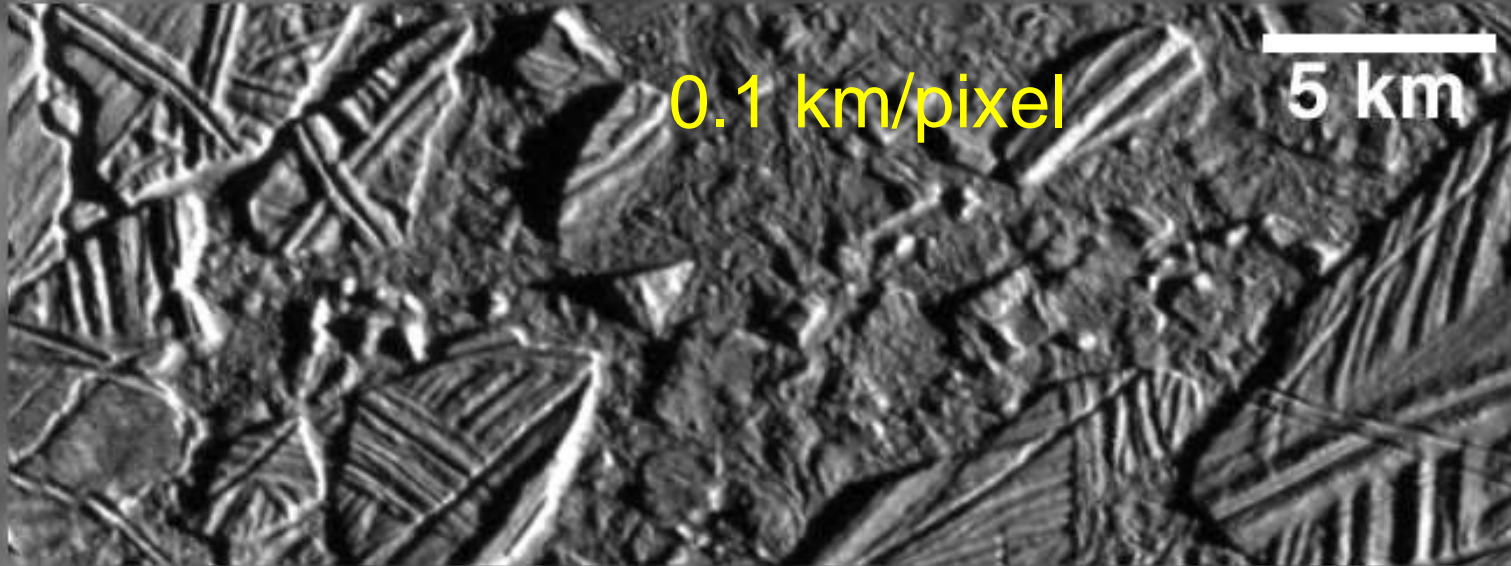
# What Do We Know about Pluto?

- Bright surface frosts of  $\text{N}_2$ ,  $\text{CH}_4$ ,  $\text{CO}$ , and  $\text{C}_2\text{H}_6$  produce albedo of  $\sim 55\%$
- Highly variegated surface (bright and dark regions)
- Reddish in color, probably due to surface organics
- Tenuous, variable atmosphere (mostly  $\text{N}_2$ ; 2-10  $\mu\text{bars}$  at the surface and going up)



*Pluto through Hubble's 'eyes,' 1994*

# New Horizons Resolution on Pluto



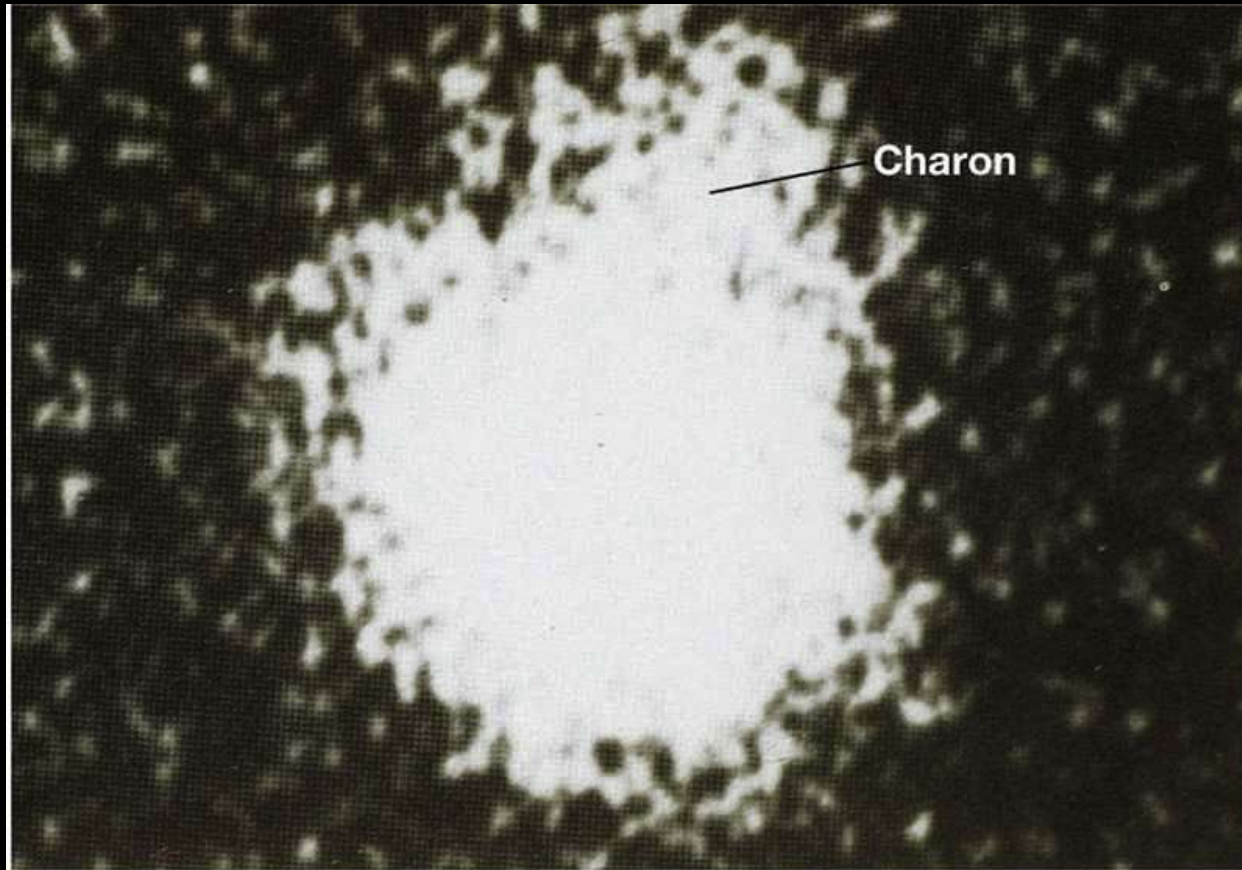
*The best we can do now*



*HST/ACS-PC: 540 km/pix*

0.6 km/pixel

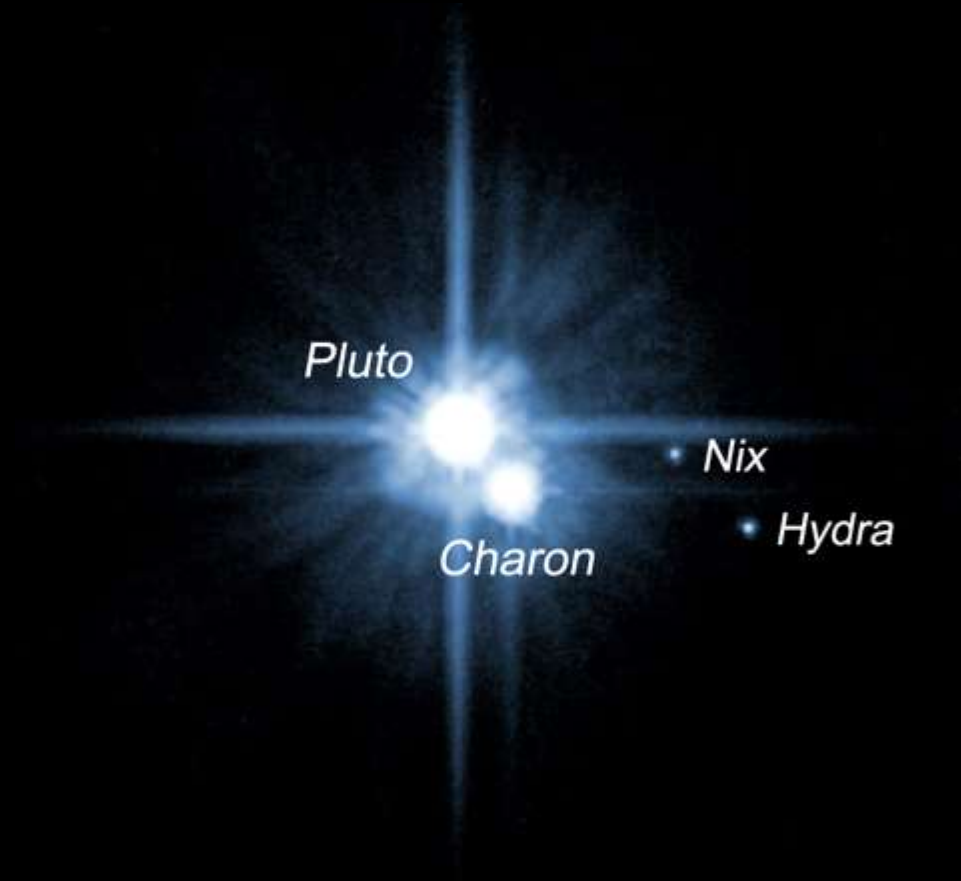
# Pluto's Satellites: Five and Counting



USNO/Flagstaff: July 1978

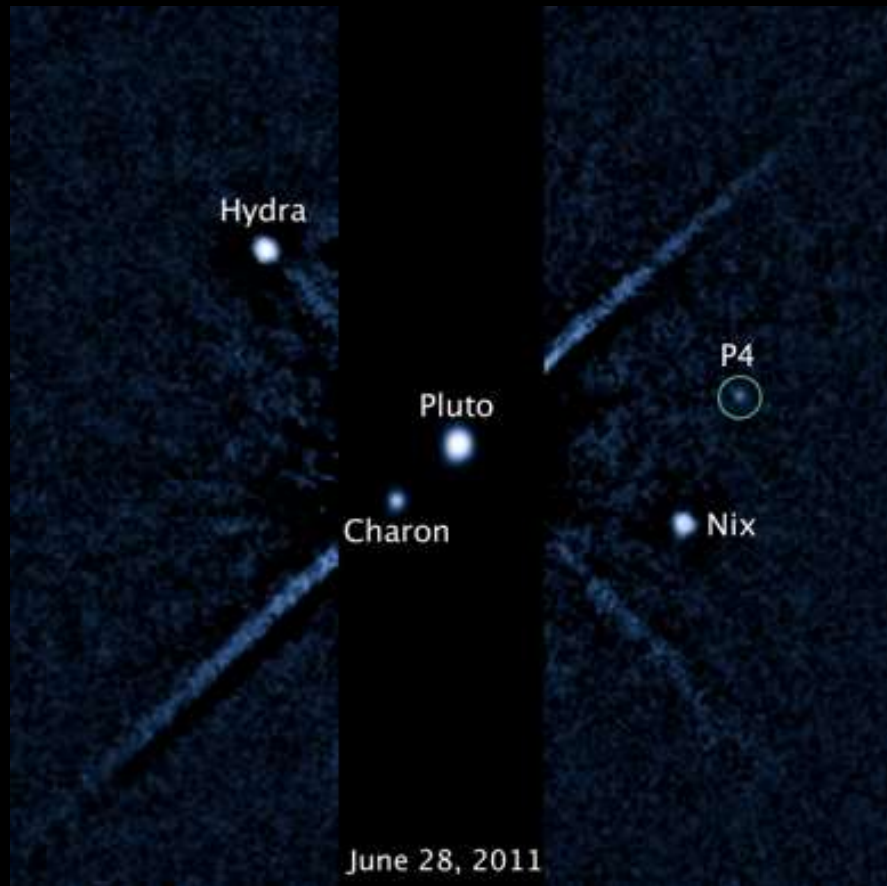


# Pluto's Satellites: Five and Counting



Hubble: May 2005

# Pluto's Satellites: Five and Counting



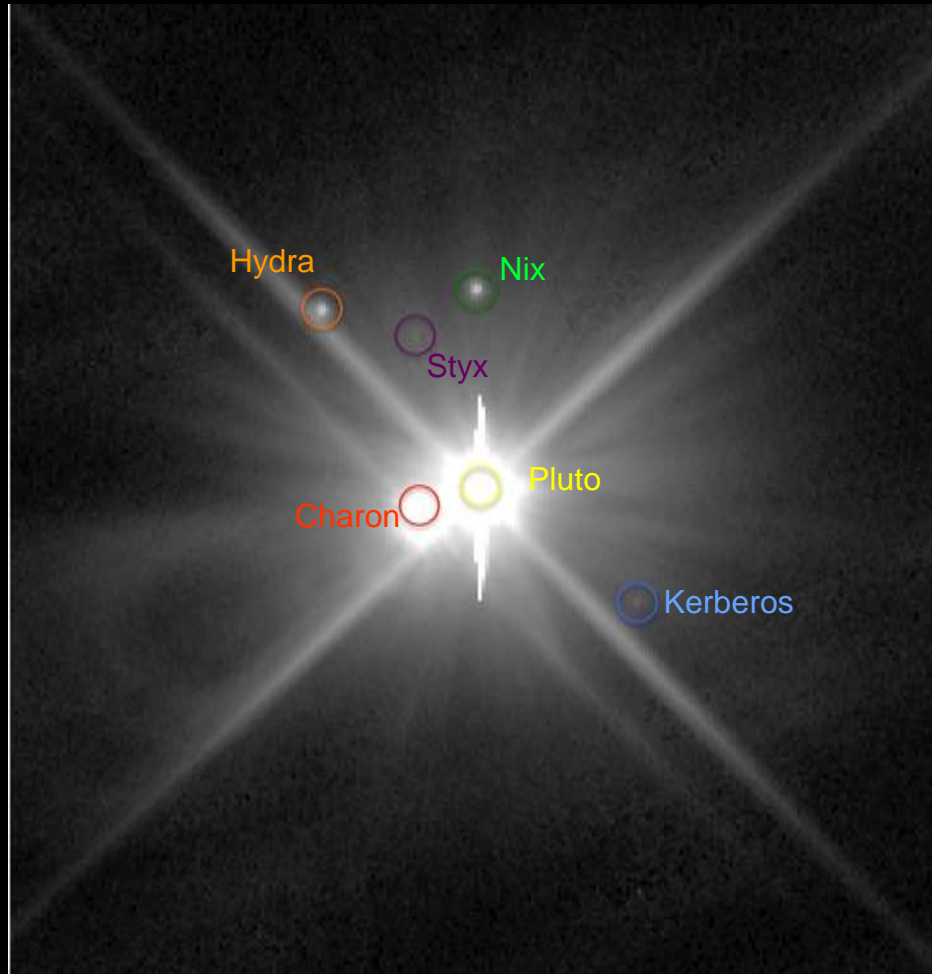
Hubble: June 2011

# Pluto's Satellites: Five and Counting



Hubble: July 2012

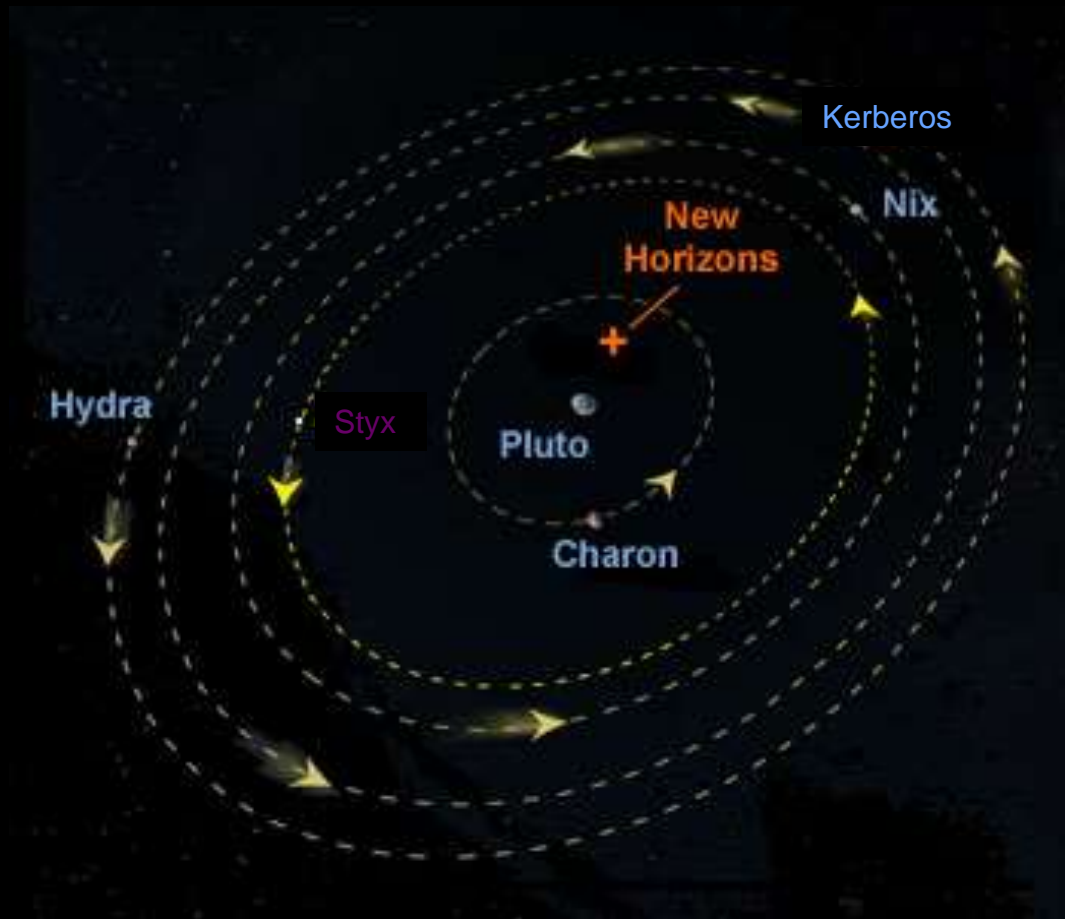
# The Pluto System: At Least *Six* Objects



- Composite Hubble WFC3 image (102 minutes total exposure time)
- Styx is ~150,000 times fainter than Pluto



# The Pluto System: At Least *Six* Objects

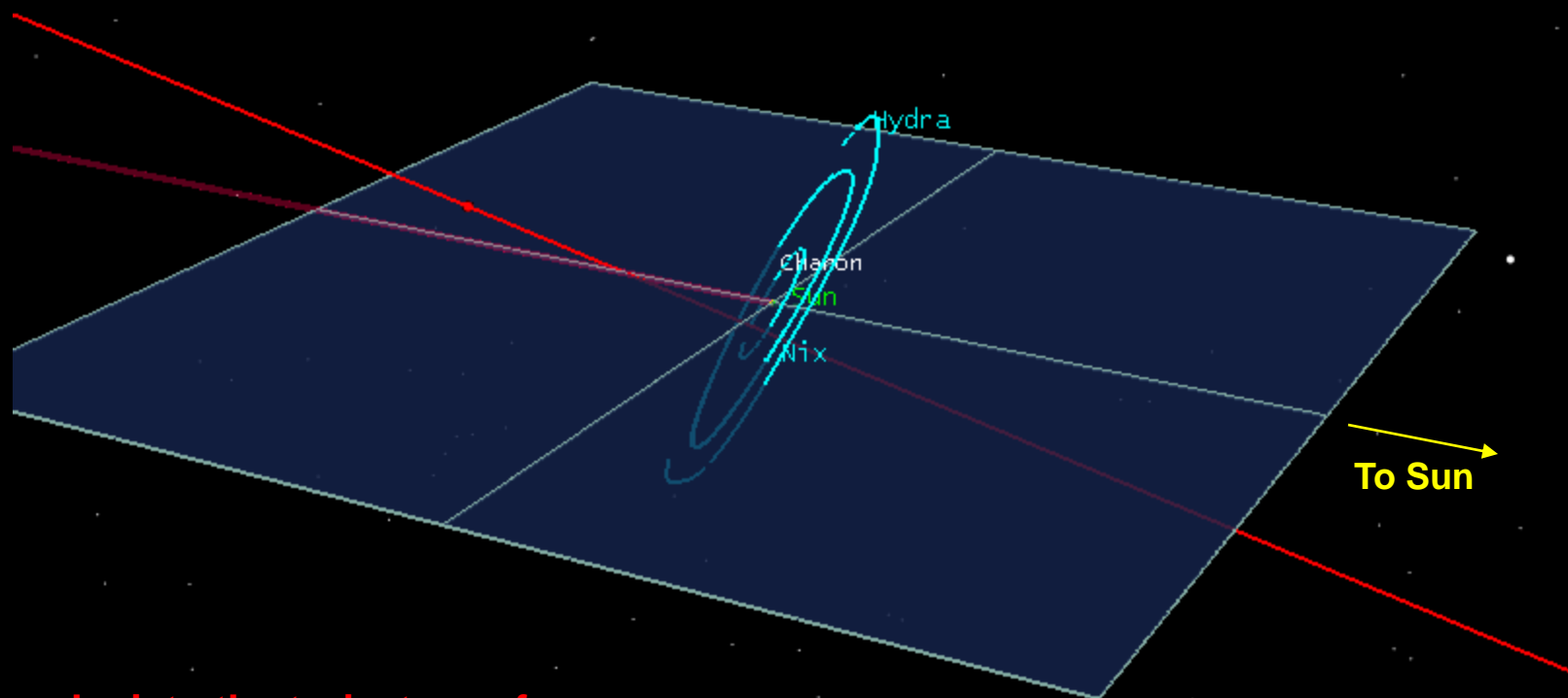


$V \approx 23.0, 23.5, 26.5, 27.0$  for  
Hydra, Nix,  
Kerberos, and  
Styx

- Satellite orbit periods are *approximately* 1:3:4:5:6
  - (Charon:Styx:Nix:Kerberos:Hydra)

# Pluto Encounter Geometry

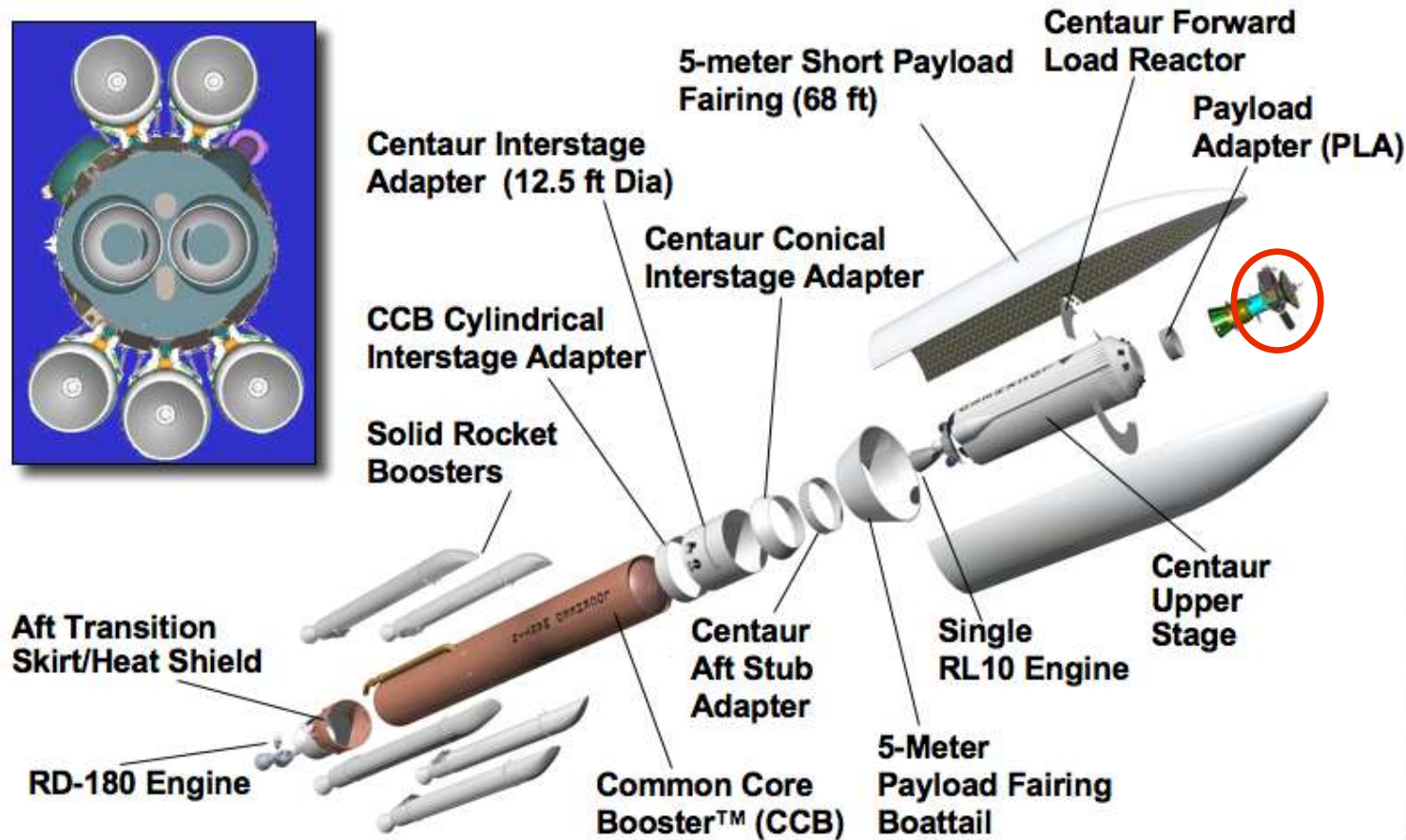
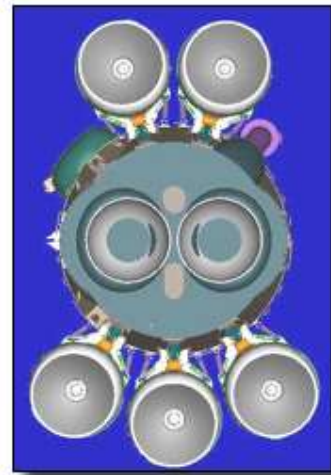
The blue plane depicts the ecliptic.



The red line depicts the trajectory of the New Horizons spacecraft.

**Gabe**

# Getting to Pluto Requires a LOT of Energy



200 ft

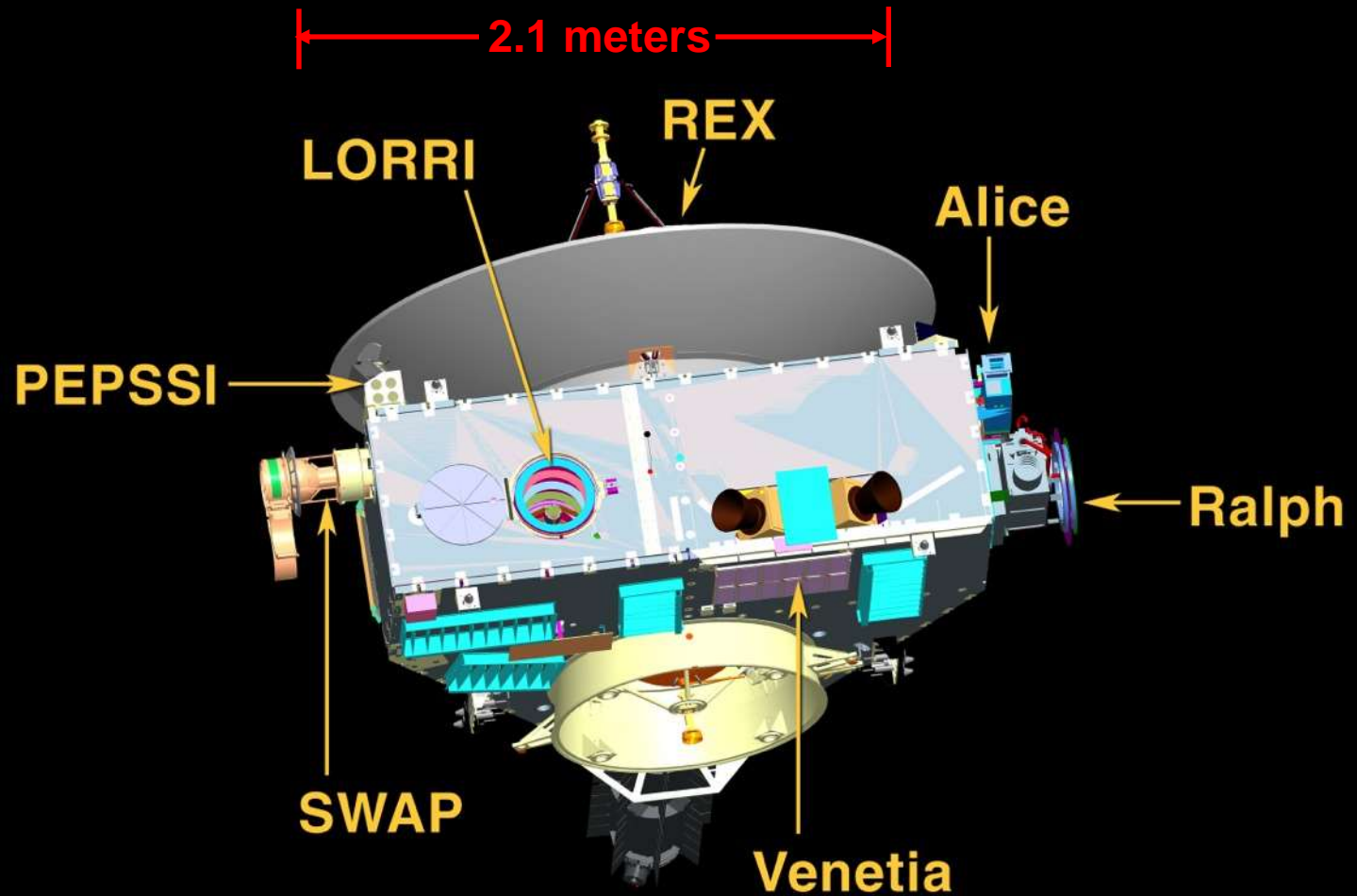


# Historic Voyage



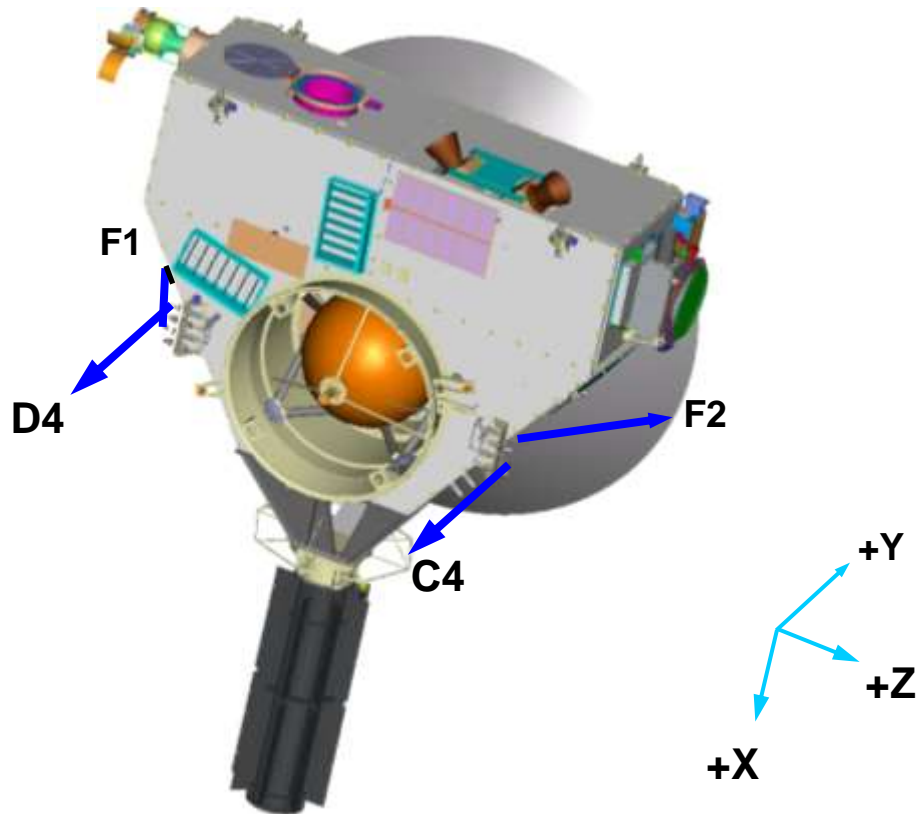
- Launched January 19, 2006
  - Atlas V 551
  - Fastest Earth departure ever (36,000 mph = 58,000 km/hr)
  - Passed moon's orbit in 9 hours
  - Passed orbits of:
    - Mars on 4/7/2006
    - Jupiter on 2/28/2007
    - Saturn on 6/8/2008
    - Uranus on 3/18/2011
    - Neptune on 8/25/2014
- Pluto system encounter on 7/14/2015
- Spacecraft mass: 1,054 lbs (478 kg)
  - 170 lbs (77 kg) of hydrazine
  - 66 lbs (30 kg) of science payload
- 200 watts of power (from RTG) at Pluto
- Mission cost: ~\$710 M (FY08)

# Spacecraft and Instruments

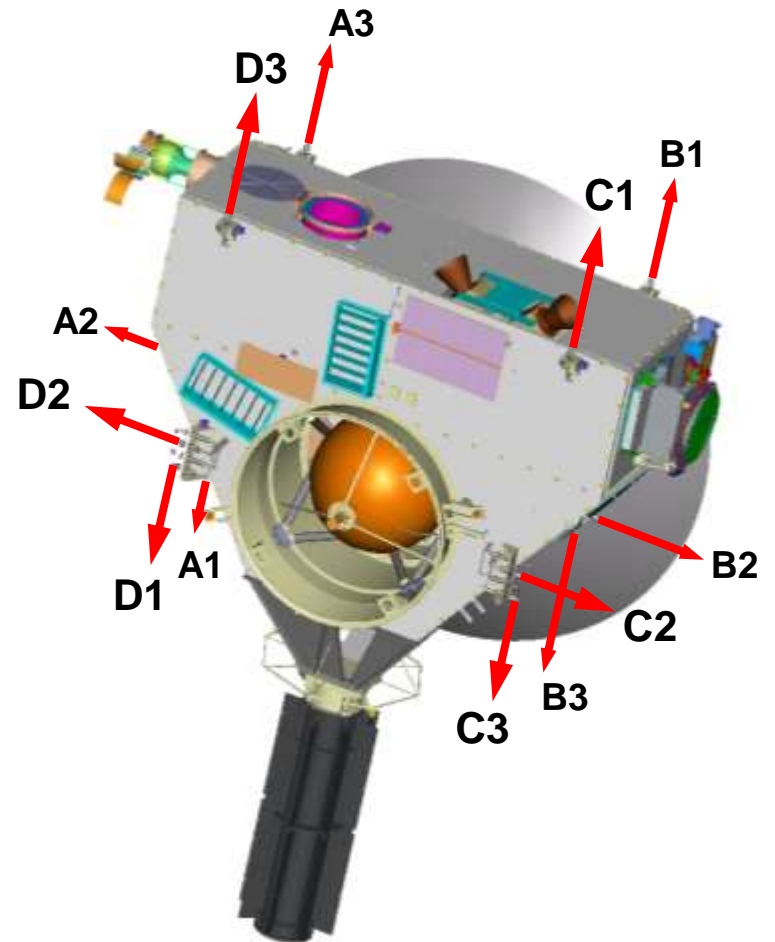


***\*All instruments performing nominally***

# 'Steering' New Horizons



***Thrusters for Trajectory Corrections***



***Thrusters to Control Pointing Attitude***

# Jupiter Gravity Assist

- Feb 28, 2007
- 2.6 million km from Jupiter
- Increased velocity by 13680 km/hr, reducing flight time by up to 5 years
- Collected Science Data to Calibrate Instruments





# Where Is New Horizons Now?

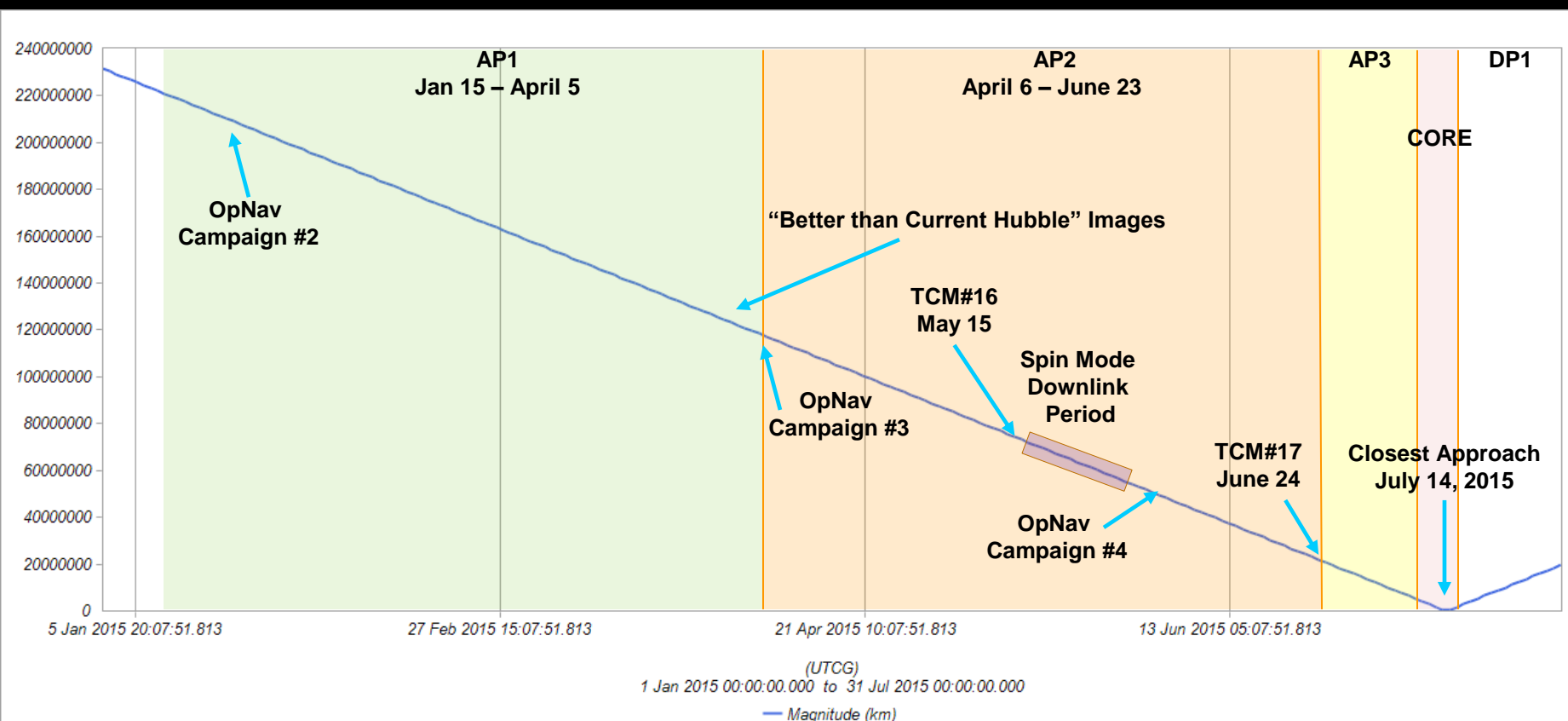
New Horizons Full Trajectory - Overhead View  
Distance from Sun (AU): 29.19 Heliocentric Velocity (km/s): 14.76



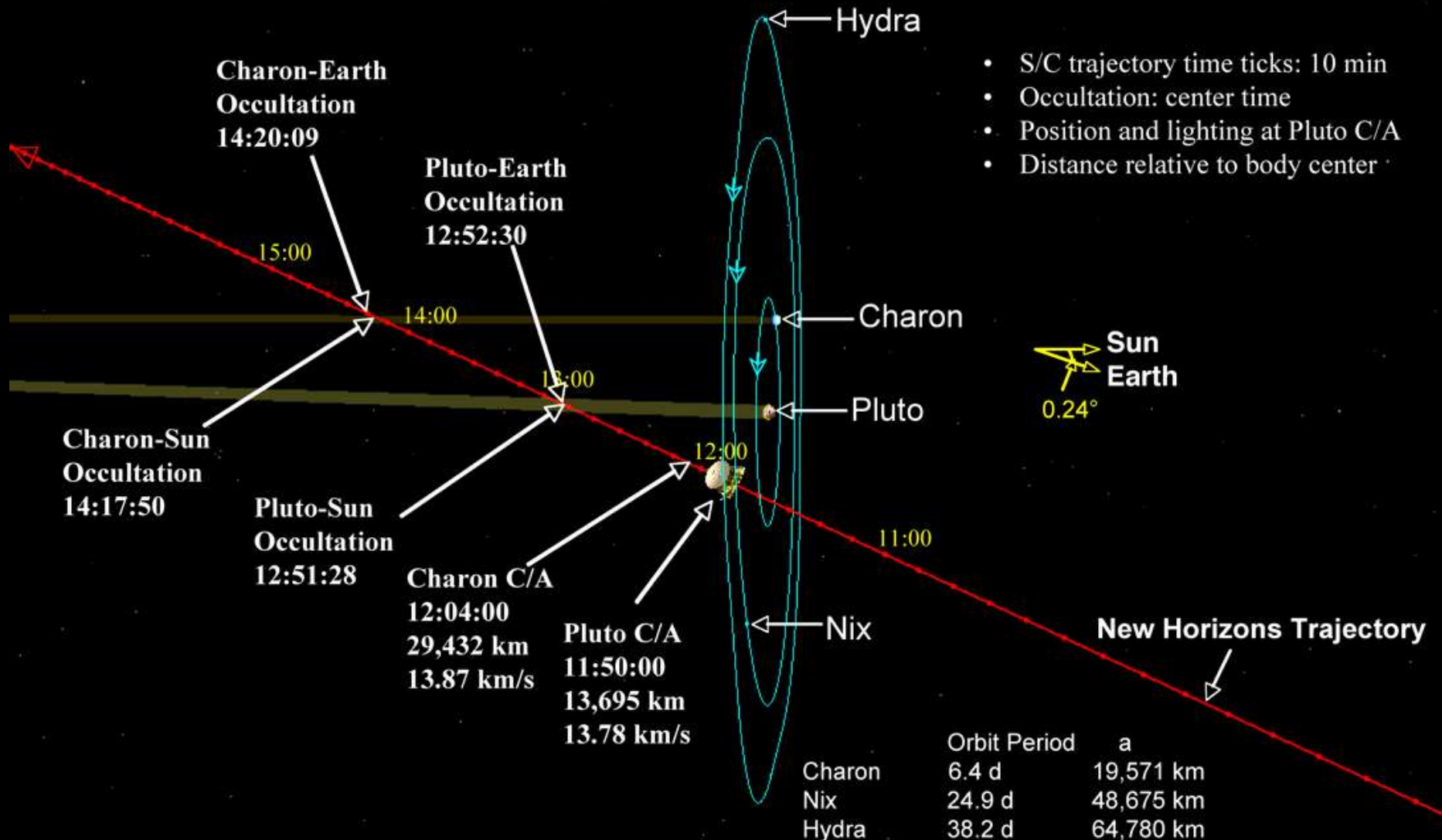
Distance from Earth (AU): 28.83  
Distance from Pluto (AU): 3.54  
Round-Trip Light Time (hh:mm:ss): 07:59:31  
25 Apr 2014 13:00:00 UTC

# What Are We Going to Do?

- Final annual checkout this summer
- 3-axis Encounter Period starts January 2, 2015
- Better than Best Hubble images: 50 days from Closest Approach
- 3-axis Encounter Period ends July 30, 2015
- 16 months to playback data



# New Horizons at Pluto



# STK movie